

THAT WHICH IS CLAIMED IS:

1. A fingerprint sensor comprising:
a substrate;
a plurality of semiconductor devices adjacent
said substrate and defining active circuit portions;
5 a first metal layer interconnecting
predetermined ones of said plurality of semiconductor
devices;
a first dielectric layer adjacent said first
metal layer;
10 a second metal layer adjacent said first
dielectric layer defining a ground plane;
a second dielectric layer adjacent said
second metal layer; and
a third metal layer adjacent said second
15 dielectric layer and comprising an array of electric
field sensing electrodes connected to active circuit
portions for generating signals related to a sensed
fingerprint.
2. A fingerprint sensor according to Claim
1 further comprising a third dielectric layer adjacent
said third metal layer.
3. A fingerprint sensor according to Claim
1 further comprising a package surrounding said
substrate and having an opening aligned with the array
of electric field sensing electrodes.
4. A fingerprint sensor according to Claim
3 further comprising a first external electrode carried
by said package for contact by a finger.
5. A fingerprint sensor according to Claim
4 further comprising excitation drive means connected
between the ground plane and said first external

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electrode for generating electric fields between the
5 electric field sensing electrodes and adjacent finger
portions.

6. A fingerprint sensor according to Claim
4 further comprising power control means for
controlling operation of active circuit portions based
upon sensing finger contact with said first external
5 electrode.

7. A fingerprint sensor according to Claim
6 wherein said power control means comprises wake-up
means for only powering active circuit portions upon
sensing finger contact with said first external
5 electrode to thereby conserve power.

8. A fingerprint sensor according to Claim
6 wherein said power control means further comprises
protection means for grounding active circuit portions
upon not sensing finger contact with said first
5 external electrode.

9. A fingerprint sensor according to Claim
3 further comprising finger charge bleed means for
bleeding a charge from a finger upon contact therewith.

10. A fingerprint sensor according to Claim
9 wherein said finger charge bleed means comprises:
a second external electrode carried by said
package for contact by a finger;
5 a charge bleed resistor connected between
said second external electrode and an earth ground.

11. A fingerprint sensor according to Claim
10 wherein said second external electrode comprises an
electrically conductive movable cover for the opening
in said package.

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12. A fingerprint sensor according to Claim 1 further comprising:

a shield electrode adjacent each electric field sensing electrode; and

5 an amplifier having an input connected to each electric field sensing electrode, and having an output connected to each respective shield electrode, said amplifier having an amplification gain greater than about one to thereby increase noise rejection.

13. A fingerprint sensor comprising:

a substrate;

a plurality of semiconductor devices adjacent said substrate and defining active circuit portions for
5 generating an output related to a sensed fingerprint;

a package surrounding said substrate;

a first external electrode carried by said package for contact by a finger; and

power control means for controlling operation
10 of active circuit portions based upon sensing finger contact with said first external electrode.

14. A fingerprint sensor according to Claim 13 further comprising at least one conductive layer comprising an array of electric field sensing electrodes connected to active circuit portions.

15. A fingerprint sensor according to Claim 14 further comprising excitation drive means connected to said first external electrode for generating electric fields between the electric field sensing
5 electrodes and adjacent finger portions.

16. A fingerprint sensor according to Claim 13 wherein said power control means comprises wake-up means for only powering active circuit portions upon

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sensing finger contact with said first external
5 electrode to thereby conserve power.

17. A fingerprint sensor according to Claim
13 wherein said power control means further comprises
protection means for grounding active circuit portions
upon not sensing finger contact with said first
5 external electrode.

18. A fingerprint sensor according to Claim
17 further comprising finger charge bleed means for
bleeding a charge from a finger upon contact therewith,
and wherein said finger charge bleed means and said
5 protection means cooperate so that active circuit
portions remain grounded until said bleed means bleeds
the charge from the finger.

19. A fingerprint sensor according to Claim
18 wherein said finger charge bleed means comprises:
a second external electrode carried by said
package for contact by a finger; and
5 a charge bleed resistor connected between
said second external electrode and an earth ground.

20. A fingerprint sensor according to Claim
19 wherein said second external electrode comprises an
electrically conductive movable cover for said package.

21. A fingerprint sensor according to Claim
19 wherein said at least one conductive layer comprises
a ground plane layer connected to said charge bleed
resistor.

22. A fingerprint sensor comprising:
a substrate;

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5 a plurality of semiconductor devices adjacent said substrate and defining active circuit portions for generating an output related to a sensed fingerprint; a package surrounding said substrate; and finger charge bleed means for bleeding a charge from a finger upon contact therewith to protect the active circuit portions.

23. A fingerprint sensor according to Claim 22 wherein said finger charge bleed means comprises: a second external electrode carried by said package for contact by a finger; and
5 a charge bleed resistor connected between said second external electrode and an earth ground.

23
24 22 24. A fingerprint sensor according to Claim 23 wherein said second external electrode comprises an electrically conductive movable cover for said package.

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25. A fingerprint sensor according to Claim 22 further comprising at least one conductive layer comprising an array of electric field sensing electrodes connected to the active circuit portions.

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24 26. A fingerprint sensor according to Claim 25 further comprising:

a first external electrode carried by said package; and
5 excitation drive means connected to said first external electrode for generating electric fields between the electric field sensing electrodes and adjacent finger portions.

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27. A fingerprint sensor comprising:
a substrate;
at least one electrically conductive layer adjacent said substrate and comprising portions

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5 defining an array of pairs of electric field sensing
electrodes and associated shield electrodes; and
a respective amplifier connected between each
pair of electric field sensing electrodes and
associated shield electrodes, each amplifier having an
10 amplification gain greater than about one to thereby
increase noise rejection.

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²⁴ 28. A fingerprint sensor according to Claim
~~27~~ wherein each amplifier has an input connected to
each electric field sensing electrode and has an output
connected to each respective shield electrode.

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²⁴ 29. A fingerprint sensor according to Claim
²⁴ 27 further comprising a plurality of semiconductor
devices adjacent said substrate and defining the
amplifiers.

30. A method for making a fingerprint sensor
comprising the steps of:

forming a plurality of semiconductor devices
adjacent a substrate and defining active circuit
5 portions;
forming a first metal layer interconnecting
predetermined ones of the plurality of semiconductor
devices;
forming a first dielectric layer adjacent the
10 first metal layer;
forming a second metal layer adjacent the
first dielectric layer defining a ground plane;
forming a second dielectric layer adjacent
the second metal layer; and
15 forming a third metal layer adjacent the
second dielectric layer and comprising an array of
electric field sensing electrodes connected to active
circuit portions for generating signals related to a
sensed fingerprint.

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~~31~~. A method according to Claim ²⁹~~30~~ further comprising the step of forming a third dielectric layer ³³~~adjacent~~ the third metal layer.

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~~32~~. A method according to Claim ²⁹~~30~~ further comprising the step of forming a package surrounding the substrate and having an opening aligned with the array of electric field sensing electrodes.

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~~33~~. A method according to Claim ³¹~~32~~ further comprising the step of forming a first external electrode carried by the package for contact by a finger.

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~~34~~. A method according to Claim ³¹~~32~~ further comprising the steps of:

forming a second external electrode carried by the package for contact by a finger; and

5 connecting a charge bleed resistor between the second external electrode and an earth ground.

35. A method for controlling operation of a fingerprint sensor of a type comprising a plurality of semiconductor devices adjacent a substrate and defining active circuit portions for generating an output related to a sensed fingerprint, a package surrounding the substrate, and a first external electrode carried by the package for contact by a finger, the method comprising the steps of:

only powering active circuit portions upon sensing finger contact with the first external electrode to thereby conserve power; and

grounding active circuit portions upon not sensing finger contact with the first external electrode.

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36. A method according to Claim ³⁴35 further comprising the step of bleeding a charge from the finger upon initial contact of the finger with the fingerprint package and before switching from grounding
5 of the active circuit portions to powering same.

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37. A method of increasing noise rejection in a fingerprint sensor of a type comprising a substrate, and at least one electrically conductive layer adjacent said substrate and comprising portions
5 defining an array of electric field sensing electrodes, the method comprising the steps of:
forming a shield electrode for each
respective electric field sensing electrode;
forming a respective amplifier connected
10 between each pair of electric field sensing electrodes and associated shield electrodes; and
operating each amplifier at an amplification gain greater than about one to thereby increase noise rejection.

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